(2)

FROM THE

JOURNAL OF ANATOMY & PHYSIOLOGY

VOL. XXV.



ROYAL COLLEGE OF SURGEONS OF ENGLAND
21 OCT 91
LIBRARY

Digitized by the Internet Archive
in 2015

https://archive.org/details/b22304198

THE SYLVIAN FISSURE AND THE ISLAND OF REIL IN THE PRIMATE BRAIN.

By D. J. Cunningham, M.D., *Professor of Anatomy, University of Dublin.*

In the following paper I purpose stating very briefly some of the results I have obtained in connection with a somewhat prolonged investigation into the anatomy of the Sylvian fissure and the island of Reil in the primate brain. I publish these in abstract in the present instance, but before very long they will be dealt with *in extenso* in Cunningham Memoir, No. VII. (*Royal Irish Academy*).

The island of Reil in the human brain is covered in typical cases by three opercula, viz., an upper or *parieto-frontal*, a lower or *temporal*, and an anterior or *fronto-orbital*. The anterior operculum is further subdivided into two distinct portions. One of these appears on the external face of the adult brain, and may be called the *frontal operculum* (pars triangularis of Eberstaller; "cap" of Broca), whilst the other is on the orbital face and may therefore be designated the *orbital operculum*.

These four opercula are separated from each other by the limbs of the Sylvian fissure. The *posterior horizontal limb* intervenes between the temporal and parieto-frontal opercula; the *anterior ascending limb* separates the parieto-frontal from the frontal operculum; and the *anterior horizontal limb* intervenes between the frontal and orbital opercula.

There has been a great deal of loose description in connection with the anterior limbs of the Sylvian fissure, and the reason of this is obvious. Different authors have had different ideas as to the characters by which an "anterior limb" should be judged. Only two have condescended to give a sufficiently precise definition. Pansch considers it a requisite that the "anterior limb" should cut right through the operculum. Eberstaller adds a still further requirement, viz., that the incision through the operculum should be so complete that it should reach the furrow surrounding the island of Reil. We hold to the latter definition.

In addition to the ascending and horizontal anterior limbs, there may be two others cutting through the short orbital

operculum. These have previously been noted by Eberstaller, whilst Zuckerkandl has observed the outer of the two.

The four anterior limbs are not constant in their relations or presence. No less than fifteen different combinations occur.

In the Negro brain there appears to be a deficiency in the orbital operculum; and the anterior orbital limbs of the Sylvian fissure which incise it are less frequently present than in the European brain.

One of the most remarkable characters in the cerebrum of the Orang and the Chimpanzee is the total absence of the frontal and orbital opercula. The temporal and parieto-frontal opercula are alone present.

There is a so-called anterior limb of the Sylvian fissure, but it hardly comes within the definition that we have given of an "anterior limb." It bounds the parieto-frontal operculum in front, it is true, and the fore-border of this operculum forms its superficial wall. It cuts into the hemisphere very obliquely, and the surface of its deep wall is carried almost continuously into the surface of the island of Reil.

It is curious that while the anthropoid should be so absolutely destitute of a frontal and an orbital operculum, there are many of the lower apes (*e.g.* Baboons, Macaques, &c., &c.,) which show a faint trace of the orbital operculum.

But it may be asked why we have so decidedly stated that the frontal operculum (pars triangularis) is absent in anthropoids, seeing that we might very well suppose that it was merely fused with the fore part of the parieto-frontal operculum. This is no doubt the view of those who hold that the so-called "anterior limb" of the Sylvian fissure is homologous with the anterior horizontal limb in man, but it is an erroneous supposition. The fact is, that if we are to regard this "anterior limb" of the Sylvian fissure in the anthropoid brain as homologous with anything, it must be with the ascending limb of the human brain, and for this reason: *the part of the island of Reil which corresponds to the frontal operculum or pars triangularis in man is absent in the anthropoid ape.*

There has been a great deal of discussion upon the third frontal convolution, and its deficiency or absence in the Ape. This is a question into which I am not prepared to enter at

present; but this much I may say, viz., that the chief difference to be noted in this region between human and anthropoid brains is, that in the latter there is no undermining of this convolution by the island of Reil in front of its pars basilaris.

But, further, another very striking difference between the human cerebrum and the anthropoid cerebrum is to be found in the relative size and in the position of the island of Reil.

If we take the length of the lateral surface of the hemisphere as being equal to 100, the average length of the insula in the European is 29·6; in the Negro, 28·3; in the Orang, 21·5; and in the Chimpanzee, 18·2.

Hefftler, Guldberg, and Eberstaller have pointed out that in man the island of Reil is divided by a well-marked furrow, termed the sulcus centralis, which has the same direction, and lies in the same plane as the fissure of Rolando, into a fore part or pars frontalis, and into a posterior portion or pars temporo-parietalis. The pars frontalis is the larger of the two, and is connected solely with the frontal lobe. The pars temporo-parietalis is connected with the parietal and temporal lobes. In the anthropoid ape, if there is any part of the pars frontalis present, it is merely that portion of it which Eberstaller terms the gyrus tertius.

It is extraordinary that in the lower apes the island of Reil should present a greater antero-posterior diameter than in the anthropoid apes. In the Macaque it is 24·9; Hamadryas, 23·9; Baboon, 27·9; Mangaby, 25·3; Cebus, 25·5.

In the human brain, if we consider the lateral length of the hemisphere to be 100, the length of the frontal operculum is 6·9, and from the period of its full development in the first year of life up to the adult condition, it does not vary. On the left side, however, it is longer than on the right side, in the proportion of 8 to 6·1. Further, it appears to be shorter in the Negro than in the European.

Topography of the Sylvian Fissure.—The point at which the trunk of the Sylvian fissure appears on the outer face of the hemisphere may be termed the "*Sylvian point.*" The position of this in the human brain varies somewhat at different periods of growth. It makes a slight advance in a forward direction as growth progresses, and it may be said to become finally fixed in its position about the eleventh year. In the adult male it is

placed slightly in front of the position which it holds in the female. There is apparently no difference in this respect between the right and left hemispheres. In the Negro it is placed further back than in the European.

In the Orang, Chimpanzee, and also in the lower apes, the "Sylvian point" is placed behind the corresponding point in the human brain, and in this respect the apes resemble more the new-born child than the human adult.

It is well known that the posterior horizontal limb of the Sylvian fissure in the last month of intra-uterine development, in the new-born infant and in the young child, lies considerably above the level of the squamous suture, but the relative position which it occupies with reference to this suture at different periods of life has not hitherto been made out.

In arriving at the following results, the measurements of the depth of the parietal and temporal lobes, and of the position of the Sylvian fissure with reference to the squamous suture, have been made along a line drawn downwards from the summit of the anterior central convolution, at right angles to the longest antero-posterior axis of the hemisphere. The entire breadth of the hemisphere along this line, from the superior border to the infero-lateral border, is reckoned as being 100.

In the adult the fissure was found to be in an equal number of cases a short distance above, a short distance below, and immediately subjacent to the suture.

In five hemispheres, *from children* ranging *from* 11 *to* 15 *years*, it was found to be in every case above the suture, the average relative distance being 3·3.

In five hemispheres, *from children* ranging *from* 4 *to* 5 *years*, the relative distance of the fissure above the squamous suture was 6·5.

In three hemispheres *from children* in the first year of life, the relative distance of the fissure above the suture was 13·6.

In six hemispheres from *the full-time fœtus*, the relative distance was 20·3.

In four hemispheres *from fœtuses* ranging *from* $7\frac{1}{2}$ *to* $8\frac{1}{2}$ *months*, the relative distance was 24.

To account for this difference in the position of the Sylvian fissure, with reference to the squamous suture at different periods

of growth, it has been supposed that, in addition to the marked changes which occur in the position of the suture itself, there is a slipping round of a portion of the outer surface of the temporal lobe so as to take up a position on the base of the cranium coincident with the marked expansion of the cranial floor of the young skull. In other words, that the infero-lateral border of the hemisphere becomes more elevated at the expense of the outer surface of the temporal lobe. This is a highly ingenious theory, and at first I was inclined to accept it; but, as my investigation advanced, I saw that it was untenable, and for this reason, that throughout all periods of growth the same sulci and the same convolutions of the temporal lobe lie between the Sylvian fissure above and the infero-lateral border of the hemisphere below.

The growth-change in the position of the suture is very marked. At first the squamo-zygomatic bone is low and does not override the lower border of the parietal, but, as growth advances, it extends more rapidly than the parietal bone, and ascends so as to overlap it to a considerable extent. The sutural line is always regarded as coinciding with the upper border of the squamous bone. The proportion of cranial vault above and below the suture line in the adult is 75–25, whilst in the last month of fœtal life it is 81·7–18·3.

But great as this growth-change is, it is more than equalled by that in the position of the Sylvian fissure on the surface of the hemisphere. The fissure descends rapidly during infancy and early childhood, so as to increase the depth of the parietal lobe and diminish that of the temporal lobe. The following are my results in this field:—

	Parietal Depth.	Temporal Depth.
Adults, . . .	69·1	30·9
From 11 to 15 years,	69·1	30·9
From 4 to 5 years,. .	65·7	34·3
First year of life, .	63·9	36·1
Full-time fœtuses, .	61·6	38·4
$7\frac{1}{2}$ to $8\frac{1}{2}$ month fœtuses	61	39·0

There is apparently no difference in this growth-change between the male and the female, but the left hemisphere lags slightly behind the right hemisphere all through.

In the first stages of the covering-in of the Sylvian fossa, the temporal operculum is much more energetic in its growth than the parieto-frontal operculum which grows down to meet it. Before long, however, the tables are turned, and the parieto-frontal takes the more prominent share in the enclosing of the insula, and there cannot be a doubt but that it is this excess of growth-energy, carried on through infancy and early childhood, which leads to the depression of the Sylvian fissure.

I shall not, in the present instance, deal with the topography of the anterior limbs of the Sylvian fissure.

Length of the Posterior Horizontal Limb of the Sylvian Fissure.—Eberstaller has stated that the Sylvian fissure is longer in the left hemisphere than in the right, and also longer in the female than in the male.

With the first part of this statement I entirely agree. Taking the lateral length of the hemisphere as 100, the length of the fissure on the left side of the adult brain is 28, whilst on the right side it is 24·4. This difference can be noted at all stages of growth.

I find little difference, however, between the relative length of the Sylvian fissure in the male and the female, and what difference there is seems to be in favour of the male.

Sylvian Angle.—By the "Sylvian angle" I mean the angle which is formed by the posterior horizontal limb of the fissure with a line drawn at right angles to the longest antero-posterior diameter of the hemisphere.

In the adult the average Sylvian angle is 67°·8, and there appears to be little or no difference in this respect between the male and the female. In the left hemisphere, however, the angle (70°·4) is more open than on the right side (66°·3), and this is a difference which exists at all periods of life. In children and infants the angle is more acute. In full-time fœtuses it was found to be 62°·1. Unlike the Rolandic angle, the Sylvian angle does not appear to be affected by the form of the head.

The foregoing is to be regarded as the barest possible outline of my results. I have avoided entering upon details in regard to methods employed, and the number of hemispheres examined in each group. With some additions, the brains and specimens which I have studied are the same as those which I used in connection with my recent investigation into the anatomy of the fissure of Rolando.